National Aeronautics and Space Administration

Silicon Nanowires in Nanoscale Chemical Detectors

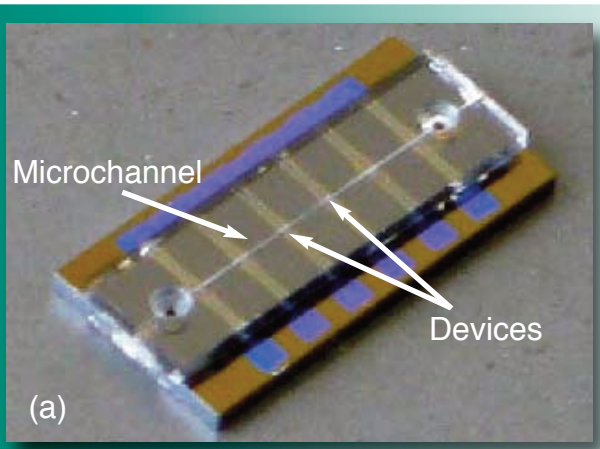
NASA Case No. GSC-15368-1
Primary Inventor: Stephanie Getty
Partnership Contact: Darryl Mitchell at
darryl.r.mitchell@nasa.gov or
301-286-5169

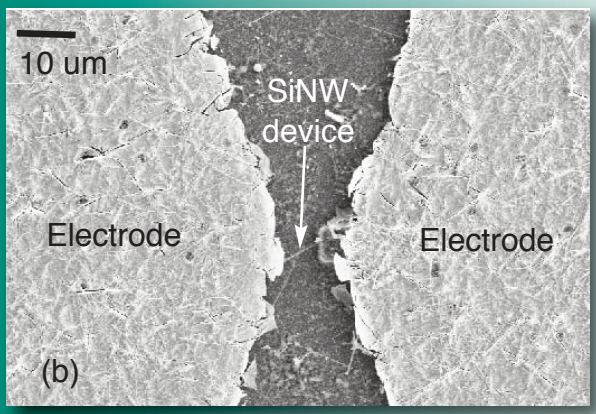
http://ipp.gsfc.nasa.gov

Inorganic semiconducting nanostructures hold substantial promise for integration into miniaturized circuits, detectors, and sensors in future devices and instruments. One barrier to integration of nanowires into mature instruments is common to all nanoscale systems: inadequacy of existing manipulation techniques toward controlled placement of nanomaterials. To date, most assembly approaches rely, to varying degrees, on statistics. One other challenge is the ability to grow nanowires so their diameters are nominally identical.

An approach for growing silicon nanowires of uniform diameter and with controlled placement has been devised. This work advances the state of technology by carefully appropriating a precise volume of catalytic seed material at well defined locations on a substrate to produce horizontally aligned, uniformly spaced nanowires of uniform diameter over a four-inch wafer using standard microfabrication techniques. This approach not only allows enhanced flexibility and compatibility with other circuit or sensor components through controlled placement but also enables the diameter to be a tunable parameter within the growth process to allow the end-user to tailor the nanowire energy scales to suit the application. This leap in technology development may enable the use of silicon nanowires in nanoscale chemical detectors with applications in astrobiology missions throughout the Solar System as well as on Earth for early detection of cancer.

(a) One of 32 die fabricated on a wafer yields six silicon nanowire devices enclosed in a microfluidic channel that each detect changes in local charge environment due to the presence of chemical analyte.
(b) Silicon nanowires are localized on an array using standard microfabrication techniques.
(c) To test the device, the microfluidic channel is housed in a fixture that mates to conventional capillary tubing.





goddard space flight center ■ technologies